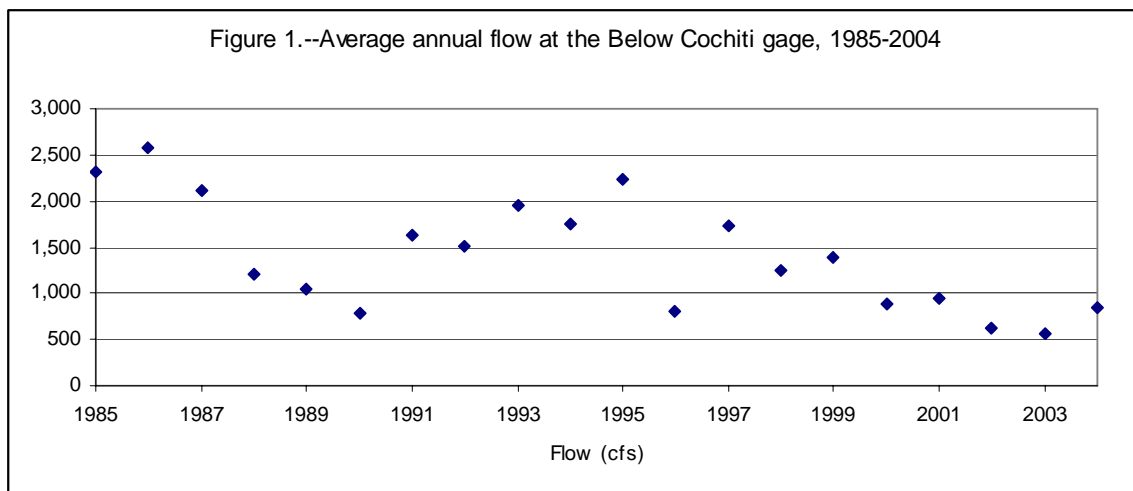


Summary report of the calibrated URGWOM for calendar years 2001 through 2004

The objective of running URGWOM for calendar years 2001-2004 was to test expectations of the model that were established using the calibrated URGWOM in the Middle Valley. A test that is independent of the calibration data requires a data set that is different than the 1985-97-time period used for calibration. This URGWOM run consisted of simulating the surface-water system in the Middle Valley for 1461 days in the 4-year time period, January 1, 2001 through December 31, 2004.

Figure 1 shows the mean annual flow at the U.S. Geological Survey gage Below Cochiti Dam for the period of record 1985-2004. Annual average flows below Cochiti Dam were almost always greater for the calibration period of record than for the 2001-2004 period of record used during this model run.



The model was run with measured Rio Grande flow below Cochiti Dam as inflow to the model. Other measured tributary inflow was also input to the model. Diversion requests were actual gaged flows in canals that divert water from the Rio Grande at Cochiti Dam, Angostura Diversion Dam, and Isleta Diversion Dam. The model solved for flow at the Central, Bernardo, and San Acacia gages on the Rio Grande. Modeled flow at gages is not allowed to go below zero, although there are days when predicted losses in the model would drive the flow below zero. Measured, historical flow ranged from about 160 to 4,090 cfs during 2001-2004 at the stream flow gage Below Cochiti Dam. The table below summarizes the expectation that the model will predict flow within plus or minus 50 cfs, or plus or minus 100 cfs, of the historical, measured flow for each downstream gaging station. The data is for a model run using the 2001-2004 period of record.

Table 1. Expectation that the linked-reach model will predict flow within plus or minus 50 cfs, or plus or minus 100 cfs of the 2001-2004 measured flow.

Reach	Expectation that the difference between modeled and historical, measured flow is within + or – 50 cfs	Expectation that the difference between modeled and historical, measured flow is within + or – 100 cfs
Cochiti to San Felipe	58%	85%
Cochiti to Albuquerque	47%	77%
Cochiti to Bernardo	34%	57%
Cochiti to San Acacia	26%	47%

The expectation that the model will predict flow within + or –50 cfs or + or –100 cfs is greater for the 2001-2004 period of record than for the 1985-97 period of record that is shown in table 2.

Table 2. Expectation that the model will predict flow within plus or minus 50 cfs, or plus or minus 100 cfs, of the historical, measured flow, for the 1985-1997 period.

Reach	Expectation that the difference between modeled and historical, measured flow is within + or – 50 cfs	Expectation that the difference between modeled and historical, measured flow is within + or – 100 cfs
Cochiti to San Felipe	40%	62%
Cochiti to Albuquerque	28%	51%
Cochiti to Bernardo	20%	36%
Cochiti to San Acacia	18%	33%

A commonly used measure of model fit is the residual flow or the difference between the historical, measured flow and the modeled flow. Errors in the model input data, inadequacies in the model's attempt to simulate the hydrologic system, and error introduced by precipitation and flow in ungaged channels cause differences between historical, measured flow and modeled flow. Accumulated residuals for the 2001 through 2004 model period is presented for each of the reaches Cochiti to San Felipe, Cochiti to Central, Cochiti to Bernardo, and Cochiti to San Acacia. These graphs can indicate bias in model results. The probability of occurrence associated with the residuals and the absolute values of the residuals gives the expected percent of the time that modeled flows will be within certain limits of historical, measured flows. Graphs of the probability density function of residuals and the cumulative probability of absolute residuals are shown for each of the calibrated reaches, (figs. 2-13). The graphs include the 1,461 days between January 1, 2001 and December 31, 2004.

Figure 2.--Cumulative residual flow (historic-modeled) at the San Felipe Gage, 2001-2004

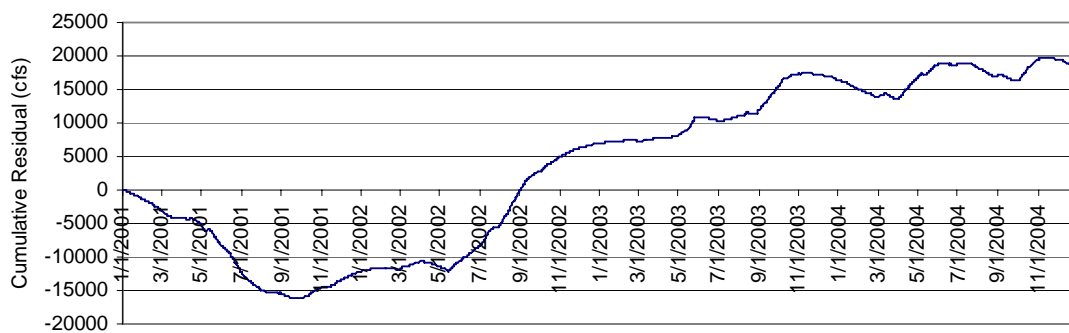


Figure 3.--Probability density function of residuals (historic-modeled) at the San Felipe gage, 2001-2004

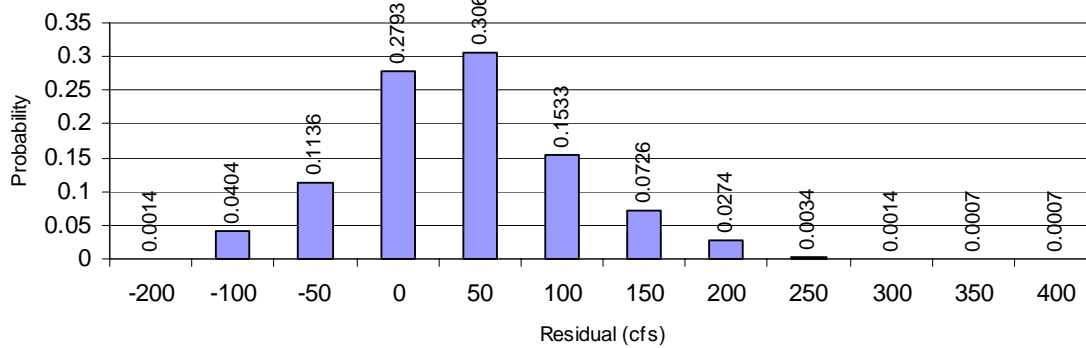


Figure 4.--Cumulative probability of absolute residual (historic-modeled) at the San Felipe Gage, 2001-2004

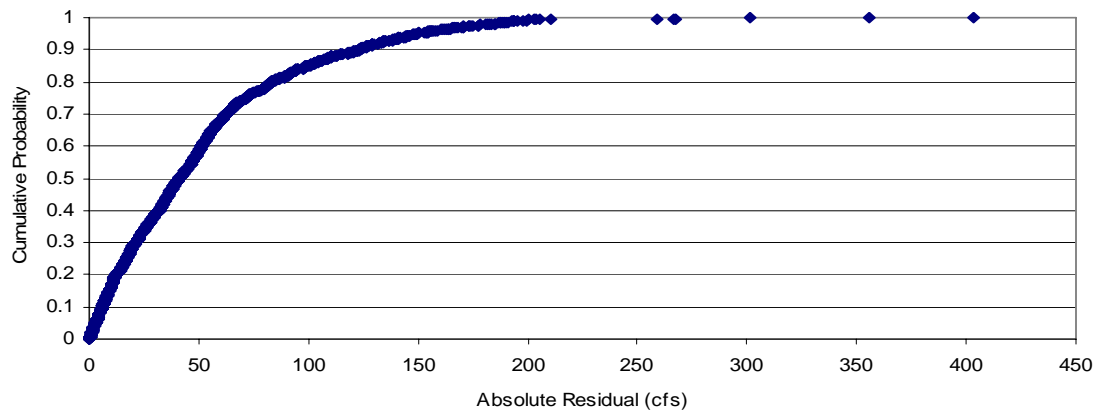


Figure 5.--Cumulative residual flow (historic-modeled) at the Central gage, 2001-2004

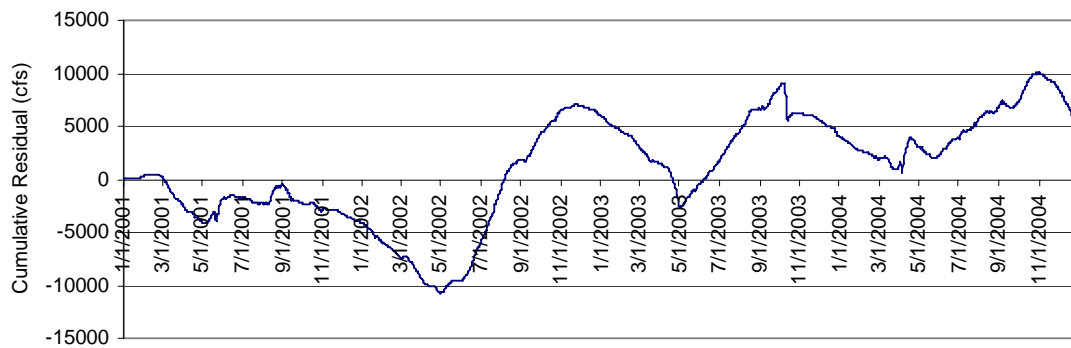


Figure 6.--Probability density function of residuals (historic-modeled) at the Central gage, 2001-2004

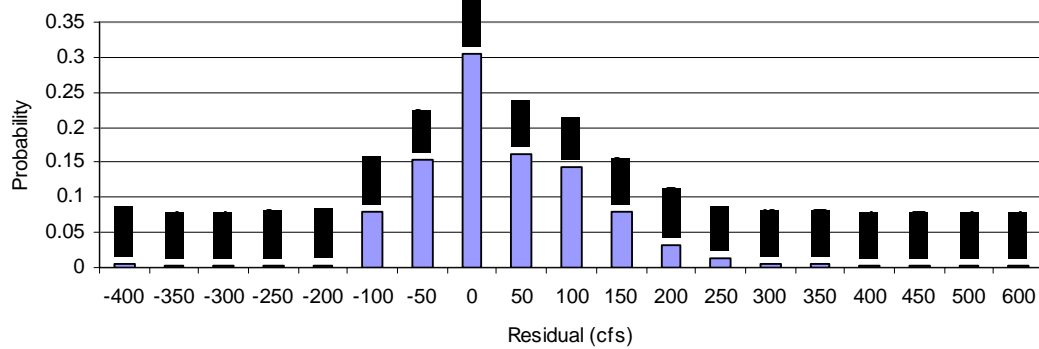


Figure 7.--Cumulative probability of absolute residual (historic-modeled) at the Central Gage, 2001-2004

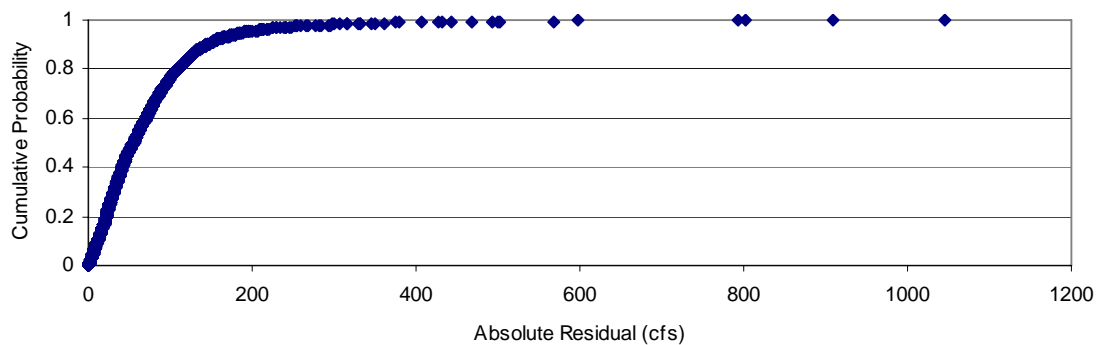


Figure 8.--Cumulative residual flow (historic-modeled) at the Bernardo Gage, 2001-2004

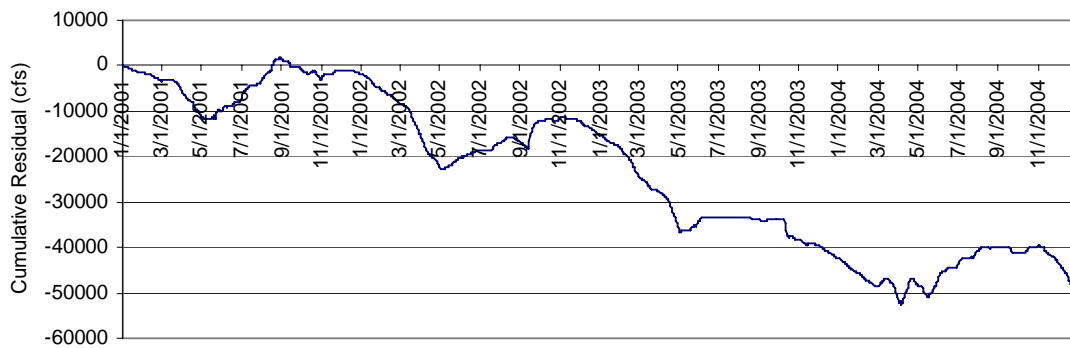


Figure 9.--Probability density function of residuals (historic-modeled) at the Bernardo gage, 2001-2004

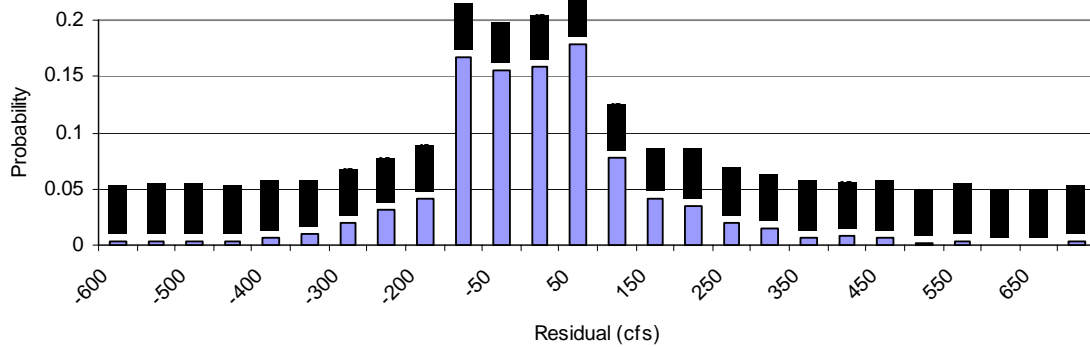


Figure 10.--Cumulative probability of absolute residual (historic-modeled) at the Bernardo Gage, 2001-2004

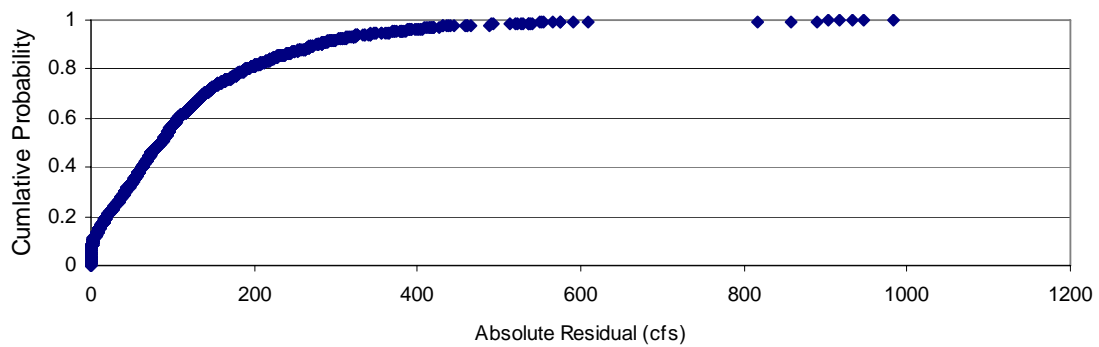


Figure 11.--Cumulative residual flow (historic-modeled) at the San Acacia Gage, 2001-2004

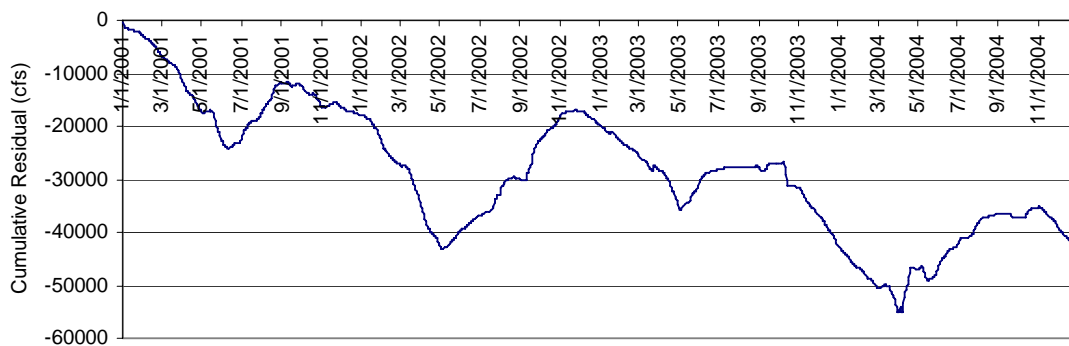


Figure 12.--Probability density function of residuals (historic-modeled) at the San Acacia gage, 2001-2004

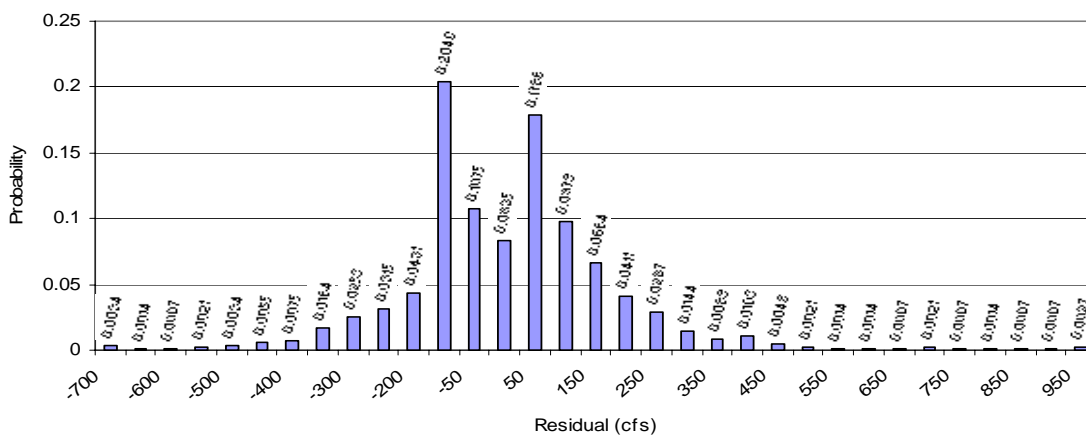
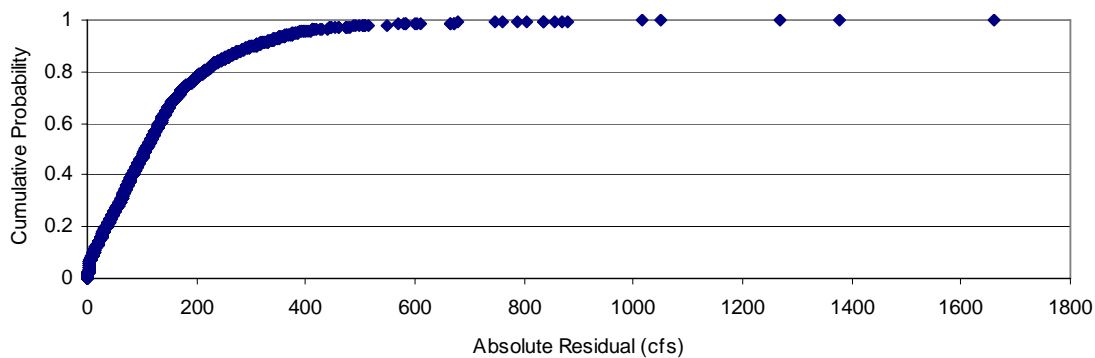


Figure 13.--Cumulative probability of absolute residual (historic-modeled) at the San Acacia Gage, 2001-2004



The difference between measured historical and modeled flow is often within the estimated percentage of stream flow gage measurement error. This indicates that some of the differences between historical and modeled flow can often be accounted for by stream flow gage measurement error. The U.S. Geological Survey, W.R.D., reports that 95 percent of daily stream flow measurements for the gages, Rio Grande at San Felipe, Rio Grande at Central Avenue, and Rio Grande at Bernardo are within plus or minus 10 percent of the true value; while 95 percent of daily stream flow measurements for the gage, Rio Grande at San Acacia are within plus or minus 15 percent of the true value. Using the plus or minus 10 percent and plus or minus 15 percent values for 100 percent of daily stream flow measurements results in the following percentage of days that stream flow measurement error can explain all of the difference between measured historical and modeled stream flow..

Table 3 Percentage of days that stream flow measurement error can explain all of the difference between measured historical and modeled stream flow.

Reach	2001-2004, non-zero, flow days that modeled flow was within 10% (or 15%) of the measured flow
Below Cochiti to San Felipe	76%
Below Cochiti to Albuquerque	49%
Below Cochiti to Bernardo	22%
Below Cochiti to San Acacia	24%

On the other days a varying percentage of the difference can be explained by stream flow measurement error, but the remainder is attributable to other factors. Possible other factors, excluding any local inflow, include errors in river-channel evaporation loss rates, river-channel leakage rates, river routing, Middle Rio Grande Conservancy District (MRGCD) diversion volumes, MRGCD agricultural depletions, bosque or riparian depletions, tributary inflow rates, canal seepage rates, irrigated-acreage deep percolation rates, and estimated crop, riparian and other land-use acreages. These other factors do not have error estimates associated with them.

Flow in the Rio Grande for the period of 2001 through 2004 is almost always less than for the URGWOM calibration period 1985 through 1997 (fig. 1). Accumulated residual flow from the simulation show that for the Below Cochiti to San Felipe reach (fig. 2) the model initially over estimates flow at San Felipe and after about September 2002 simulated flow is under estimated relative to historical flow data. Accumulated residual flow from the simulation show that for the San Felipe to Central reach (fig. 5) the model initially over estimates flow at Central and after about August 2002 simulated flow is under estimated relative to historical flow data. For the Central to Bernardo reach (fig. 8) simulated flow is always over estimated except for a few days in late August and early September of 2001. In the Bernardo to San Acacia reach (fig. 11) the model always over estimates flows at the San Acacia gage.

Table 4 shows that as the simulation progress downstream the probability of modeled flow being between – 50 and 0 cfs of the gage flow decreases from 0.30 at San Felipe to

0.11 at San Acacia and the probability of flow being between 0 and 50 cfs of gage flow from 0.31 at San Felipe to 0.08 at San Acacia. The absolute residual flow at the 4 downstream gages at 95 percent probability increased from + or - 149 cfs at San Felipe to + or - 382 cfs at San Acacia.

Table 4. Summary statistics for URGWOM reaches Below Cochiti to San Acacia, 2001-2004

Reach	Probability for the -50 cfs to 0 cfs residual range	Probability for the 0 cfs to 50 cfs residual range	Absolute residual at 95 percent probability (cfs)
Below Cochiti to San Felipe	0.28	0.31	149
San Felipe to Central	0.31	0.16	188
Central to Bernardo	0.16	0.18	366
Bernardo to San Acacia	0.08	0.18	382

Figures 14-17 show accumulated historic and modeled volume flowing past the 4 gages represented in the model. The percent difference in the total historic minus modeled flow volume after simulating the Middle Valley for 4 years (2001-2004) is 1.6 percent difference, under estimated, at San Felipe, 0.53 percent difference, under estimated, at the Central gage, -9.02 percent difference, over estimated, at the Bernardo floodway gage, and -6.44 percent difference, over estimated, at the San Acacia floodway gage.

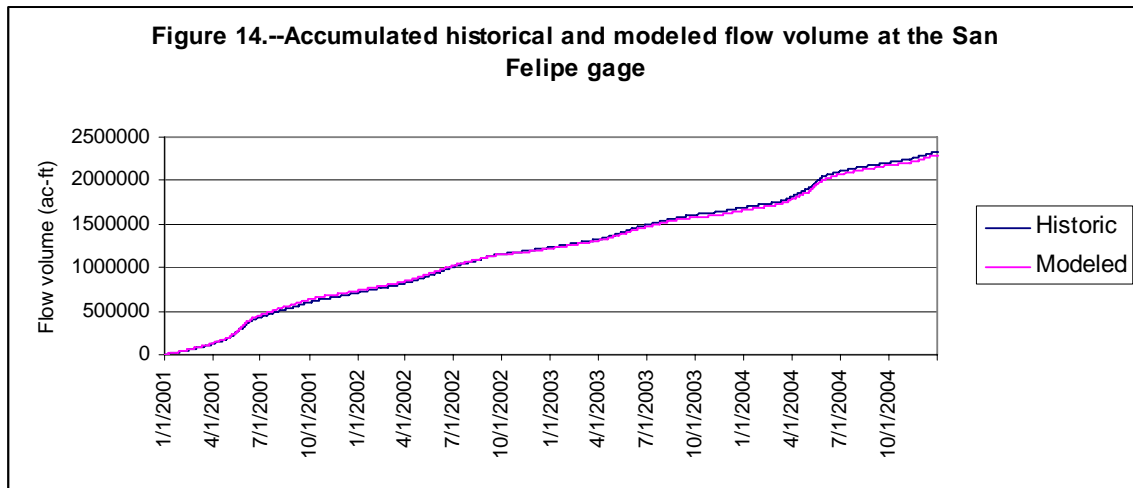


Figure 15.--Accumulated historical and modeled flow volume at the Central gage

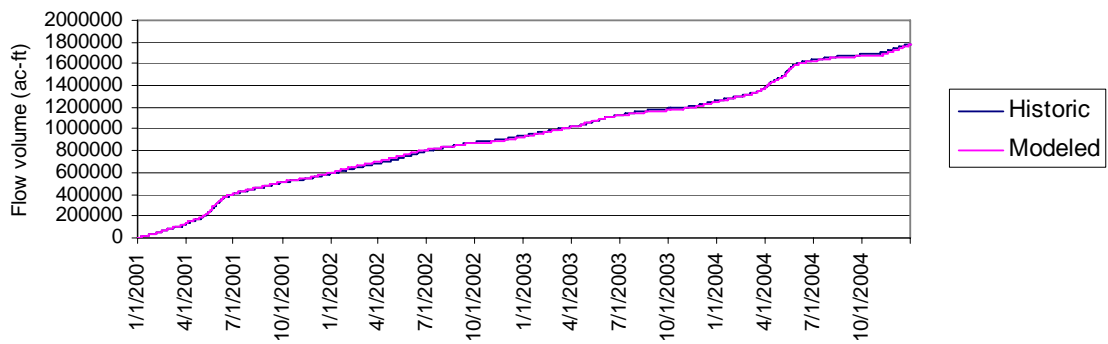


Figure 16.--Accumulated historical and modeled flow volume at the Bernardo Floodway gage

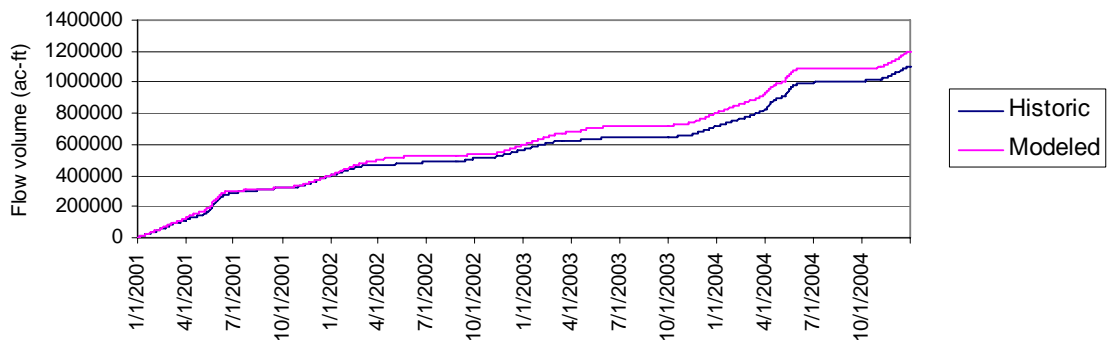


Figure 17.--Accumulated historical and modeled flow volume at the San Acacia Floodway gage

